TIMBER MANAGEMENT PLAN FOR THE KAWISHIWI WORKING CIRCLE

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For the

KAWISHIWI WORKING CIRCLE

by

C. A. Samuelson

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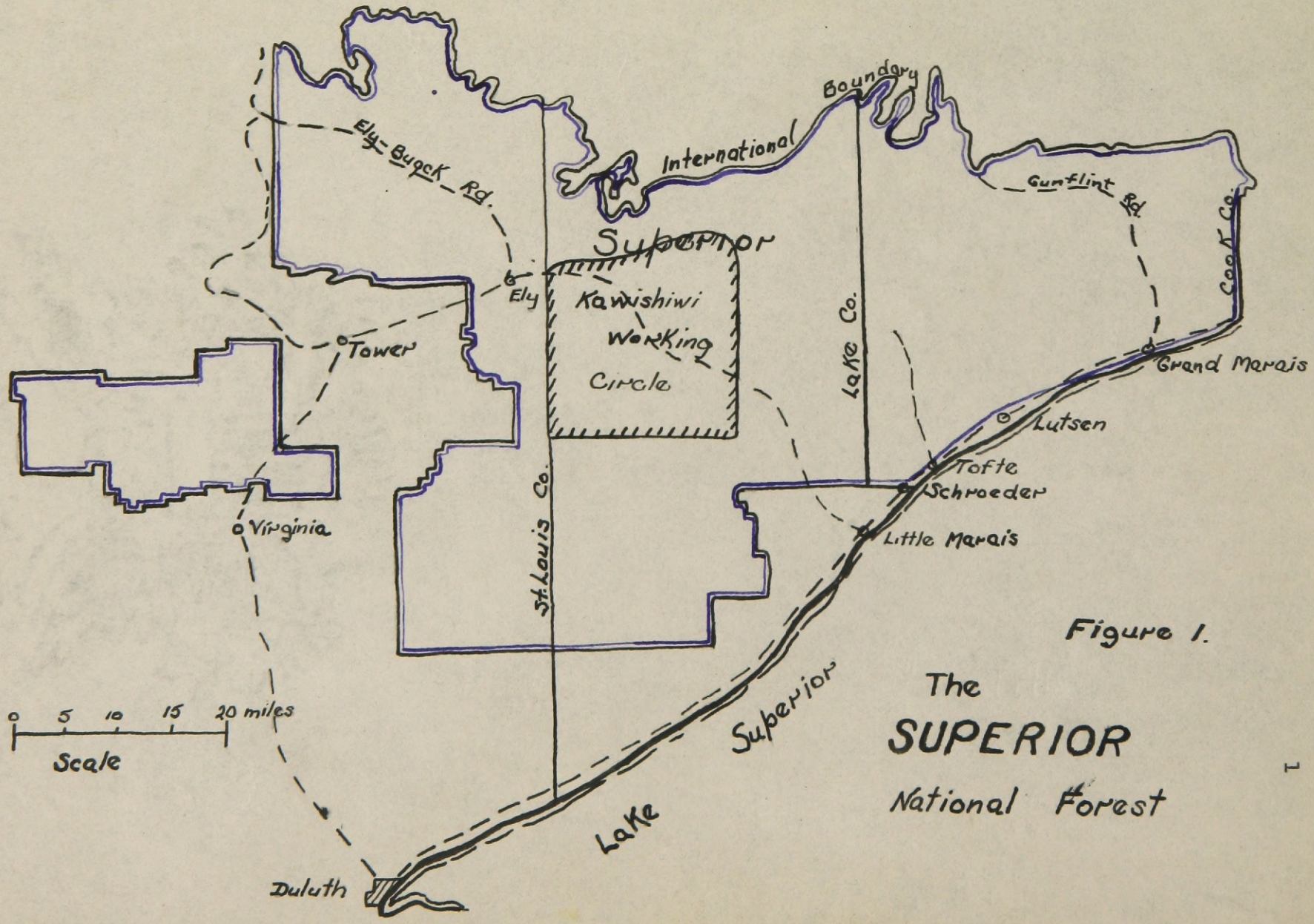

Figure 1.

The
SUPERIOR
National Forest

TIMBER MANAGEMENT PLAN

For the

KAWISHIWI WORKING CIRCLE

The Kawishiwi Working Circle includes an area of 223,207 acres of out-crop lands located in the Superior National Forest.[1] (Figure 1) It is definitely bounded on the south by the township line between T.60N., and T.59N., on the east by the range line between R.9W., and R.8W., 4 P.M. and on the west and north by the Superior National Forest Boundary. (Figure 2) The largest adjacent city is Ely, Minnesota, situated just northwest of the Working Circle on the Duluth and Iron Range Railroad.

Land within the Working Circle is under the jurisdiction of the United States Forest Service and the Minnesota State Forest Service. At present, ninety percent is federal owned, and ten percent is controlled by the State of Minnesota.

General Objective

To regulate the growing stock of the Kawishiwi Working Circle so that it may be capable of continuous production.

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1 The Superior National Forest is located in the northeastern corner of Minnesota and is under the administration of the United States Forest Service.

Requirements

In the process of organizing the forest to assure continuous production or sustained yield, definite requirements have been established and are listed as follows:

1. The chief product of the Kawishhiwi Working Circle is pulp-wood. Regulate forest on most profitable pulp-wood rotation.

2. Regulate Working Circle so that an even distribution of annual yields, or as even a distribution of annual yields as possible may be realized.

3. Cut no timber less than rotation age.

The Lake States Experimental Station recommends the following rotations for the principal species on the Superior National Forest.

Norway pine	100	years for saw logs
White pine	100	years for saw logs
Jack pine	60	years for pulp
Spruce	80	years for swamp;
	70	years for high-land
Aspen	50	years for pulp
Birch	120	years for ties & misc. products
Balsam	50	years for pulp
Tamarack	60	years for products for mine use
Cedar	80	years for poles, posts, & ties

The Cover Types

Approximately one-third of the Kawishiwi Working Circle area supports commercial timber or commercial pulp-wood types. The area of

commercial timber and pulp stands is approximately equal. Ninety-four percent is timber producing land now stocked with commercial species. Only six percent of the Working Circle is in non-productive swamp or highland and swamp brush land.

Acreage of Size Classes-------All Types

	Acres
Commercial timber - saw logs	36,106
Commercial pulp-wood - poles	35,149
Pole stands other than pulp species	8,850
Saplings	61,134
Reproduction	68,002
	209,241
Not restocking naturally	13,966
Total	223,207

Acreage of Commercial Timber Types

	Acres
Jack pine	24,526
Aspen	11,580
	36,106

Acreage of Commercial Pulp-wood Types

	Acres
Jack pine	1,720
Aspen	19,071
Spruce	13,424
Balsam	2,697
	36,912

The Timber Estimate

The Kawishiwi Working Circle now contains 326,415,000 board feet of saw log timber, 468,320 cords of miscellaneous pulp-wood species, and 3,367,557 poles of birch, white pine and Norway pine. Approximately 100 percent of the total number of poles is birch as there are only 9,217 poles of white pine and Norway pine. All saw log timber converted at the rate of 500 board feet per cord and poles at the rate of .05 cords per pole results in a total volume cord measure of 1,289,598 cords on the 223,207 acres under consideration.

Direct estimates were made on the saw log and pole types. (See Appendix for definition of saw log and pole types.) In preparation of this report the birch pole type was not considered because at present it is only 80 years in age and will not reach maturity for another 40 years. The commercial types considered, namely, the jack pine saw log, jack pine pole, aspen saw log, aspen pole, spruce pole, and balsam pole support 1,147,814 cords or an average of about 16 cords per acre on 71,255 acres. Table II gives the estimate in detail for these types which are summarized in Table I.

TABLE I. TOTAL VOLUME SUMMARY

Species	M.B.M.	Cords	Poles	Cedar posts	Cedar poles
Jack Pine	217,847	124,725			
Aspen	75,665	158,729			
Spruce	19,234	164,853			
Birch	11,347		3,358,340		
W. Pine	976		8,207		
N. Pine	183		1,010		
Balsam	1,163	20,083			
Cedar				9,110	
	326,415	468,390	3,367,557	9,110	

TABLE II. TOTAL STAND BY TIMBER AND POLE TYPES AND SPECIES---TIMBER TYPES

	Jack Pine Saw logs		Jack Pine Poles		Aspen Saw log		Aspen poles		Spruce Poles		Balsam Poles	
	Per A. cds.	Total cds.	Per A. cds.	Total cds.	Per A. cds.	Total cds.	Per A. cds.	Total cds.	Per A. cds.	Total cds.	Per A. cds.	Total cds.
Jack Pine	16.7	409,249	14.38	24,718	2.73	31,331	1.74	33,053	1.26	16,928		
Aspen	2.73	67,090	1.53	2,630	9.33	108,006	5.08	96,688	.53	7,123	1.03	962
Spruce	1.44	35,554	1.32	2,277	1.10	12,740	.79	15,086	10.10	135,724	2.08	1,940
Birch	1.43	35,277	.61	1,055	2.03	23,487	1.66	31,490	.80	10,643	.25	233
White Pine	.02	445	.07	127	.06	718	.03	576	.04	496		
Norway Pine	.00	56	.04	73	.01	134	.01	143	.00	10		
Balsam	.09	2,226	.30	520	.24	2,730	.10	2,040	.63	8,473	6.87	6,420
Total	22.41	549,897	18.25	31,400	15.5	179,146	9.41	179,076	13.36	179,397	10.23	9,555
Type acreage		24,526		1,720		11,580		19,071		13,423		935

SILVICULTURAL TREATMENT AND METHOD OF CUTTING

Jack Pine Type

Experiments carried out by the Lake States Forest Experimental Station on the Superior National Forest indicate that reproduction on jack pine types can be safely (Surely?) attained. Duff is removed in troughs by the use of plows, during the month of October or just before the first snowfall. The timber is clear cut in January, February, and March, and the slash is carefully lopped and scattered. By early summer the cones are dried out sufficiently to permit some seed to fall from jack pine cones. Germination of seeds takes place in July, allowing seedlings to catch before the fall rains.

Aspen Type

Clear cutting operations in aspen stands on the Superior have in no way hindered reproduction. It is therefore recommended that clear cutting and seeding from the side be practiced on the Kawishiwi Working Circle in the aspen types.

Spruce Type

Further experiments by the Lake States Forest Experimental Station indicate that partial or clear cutting will result in abundant

reproduction. Partial cutting, using a six inch flexible diameter limit, is recommended. In making use of the flexible diameter limit leave six trees in clumps of trees that would result in windfall if the six inch trees were cut, or clear cut entire clump attempting to obtain as many merchantible pulp sticks as possible.

Balsam Type

Clear cutting is recommended, attempting to introduce more valuable species such as spruce or cedar.

ALLOWABLE CUT AND ITS REGULATION

In determining the allowable cut, the total acreage of all timber producing areas is considered. The total acreage of jack pine saw log, pole, sapling and reproduction types is added and the total area is regulated as a separate unit of the Working Circle. Spruce, aspen, and balsam types are managed in a like manner. Ages must be assigned to the saw log, pole, sapling, and reproduction size classes. This information was obtained from timber survey data. Acreage of jack pine, aspen, spruce, and balsam types and their assigned age classes are summarized in Table III.

TABLE III. AGE CLASSES AND TOTAL ACREAGE OF COVER TYPES

	Aspen		Jack Pine		Spruce		Balsam	
	Age Class	Acre-age	Age Class	Acre-age	Age Class	Acre-age	Age Class	Acre-age
Reproduction	0-20	15,450	0-20	25,659	0-30	10,675	0-20	531
Sapling	21-40	3,778	21-40	15,356	31-60	25,264	21-40	1,231
Poles	41-60	19,071	41-60	1,720	61-90	13,423	41-60	935
Saw Logs	61-80	11,580	61-80	24,526				
Total		49,879		67,261		49,362		2,697

Keeping in mind the rotations recommended for jack pine, aspen, spruce, and balsam to be 60, 50, 80, and 50 years respectively, and above available information (Tables II and III) the compilation of Tables IV, V, VI, and VII is permitted.

TABLE IV. JACK PINE TYPES---Distribution of Age Classes and Estimated Volume per Acre.

Age Classes Years	Area acres	% of total area	Empericial yield data, vol. per acre, cords.	Estimated total vol. cords.
0-20	25,659	38.2		
21-40	15,356	22.8		
41-60	1,720	2.6	18.25	31,400
61-80	24,526	36.4	22.41	549,895
Total	67,261	100.		581,295

TABLE V. ASPEN TYPES---Distribution of Age Classes and Estimated Volume per Acre

Age Classes Years	Area acres	% of total area	Empirical Yield data, vol. acre, cords.	Estimated total vol. cords.
0-20	15,450	31.0		
21-40	3,778	7.6		
41-60	19,071	38.2	9.41	179,076
61-80	11,580	23.2	15.5	179,146
Total	49,879	100.		358,222

TABLE VI. SPRUCE TYPES---Distribution of Age Classes and Estimated Volume per Acre

Age Classes Years	Area acres	% of total area	Empirical Yield data, vol. per acre, cords	Estimated total vol. cords.
0-30	10,675	21.6		
31-60	25,264	51.2		
61-90	13,423	27.2	13.36	179,397
Total	49,362	100.0		179,397

TABLE VII. BALSAM TYPES---Distribution of Age Classes and Estimated Volume per Acre

Age Classes Years	Area in acres	% of total area	Empirical Yield data, vol. per acre, cords	Estimated total vol. cords.
0-20	531	19.7		
21-40	1,231	45.6		
41-60	935	34.7	10.22	9,555
Total	2,695	100.0		9,555

From the above data, a fairly accurate forecast can be made of the annual yields that may be expected under area regulation for the rotations recommended. This forecast can be made from Tables IV, V, VI,

and VII, however, a graphic presentation in the form of diagrams of the growing stock conditions for the representative areas of "R" acres (number of acres equivalent to rotation age) will best illustrate the actual distribution of the growing stock through the various age classes and the results of area regulation.

The number of acres which represent each age class in the jack pine, aspen, spruce, and balsam types in the representative areas of 60, 50, 80, and 50 acres respectively can be calculated from the area percentage figures in Tables IV, V, VI, and VII. (Tables VIII, IX, X, and XI)

TABLE VIII. JACK PINE---Area Percentage Figures of Representative 60 Acres

Age Class Years	% of total area	Acres in representative 60 acre area	Empirical yield data, vol. per acre cords.
0-20	38.2	22.9	
21-40	22.8	13.7	
41-60	2.6	1.6	18.25
61-80	36.4	21.8	22.41
Total	100.	60.	

TABLE IX. ASPEN---Area Percentage Figures of Representative 50 Acres

Age Class Years	% of total area	Acres in representative 50 acre area	Empirical yield data, vol. per acre cords.
0-20	31.0	15.5	
21-40	7.6	3.8	
41-60	38.2	19.1	9.41
61-80	23.2	11.6	15.5
Total	100.	50.	

TABLE X. SPRUCE---Area Percentage Figures of Representative 80 Acres

Age Class Years	% of total area	Acres in representative 80 acre area	Empirical yield data, vol. per acre cords.
0-30	21.6	17.3	
31-60	51.2	41.0	
61-90	27.2	21.7	13.36
Total	100.	80.	

TABLE XI. BALSAM---Area Percentage Figures of Representative 50 Acres

Age Class Years	% of total area	Acres in representative 50 acre area	Empiricial Yield data, vol. per acre, cords.
0-20	19.7	9.9	
21-40	45.6	22.8	
41-60	34.7	17.3	10.22
Total	100.	50.	

Since no timber less than rotation age is to be cut, volume data for age classes below 60, 50, 80, and 50 years in jack pine, aspen, spruce and balsam types, respectively, are not significant. Volumes at rotation age of the four concerned types and the older stands need only be presented in the diagrams. Volumes at rotation age of these types are not definitely stated in the empirical yield data, and must be derived from data in Tables VIII, IX, X, and XI. In the jack pine type, the average yields are given for the 41 to 60, and 61 to 80 age classes, and will have to be assumed as the yield at 60 years; in the spruce type, the average yield given for the 61-90 age class will be to be assumed as the yield at 80 years; in the aspen type, the average yield given for the 41-60 age class will have to be assumed as the yield at 50 years; and likewise, in the balsam type, the average yield given for the 41-60 age class will

have to be assumed as the yield at 50 years. The average volumes in the jack pine, aspen, spruce, and balsam types are 20.33, 9.41, 13.36, and 10.22 cords per acre, respectively. The potential production line of the diagrams for each type will rise from the zero point of both scales to the assumed volume at rotation age. (Figures 3, 4, 5, and 6) The actual volume of the age classes above rotation age and those including the recommended rotation age are plotted over their respective areas, and the potential volumes of the age classes below the age class which includes the recommended rotation are read from the potential production line and plotted in at points corresponding to their location by age and area. (Figures 3, 4, 5, and 6)

These diagrams indicate that the aspen, spruce, and balsam types can be managed on area regulation and still having no timber cut under rotation age. In order to regulate the jack pine type so that no timber under rotation age will be cut, modified area regulation is necessary.

The annual cuts from each type that may be expected throughout the first rotation can be estimated by adding the year of cut, as shown on the diagram to the average age of the various age classes and assuming that the volumes available per acre will be as indicated by the yield-table data for the ages thus determined. This can best be done by periods.

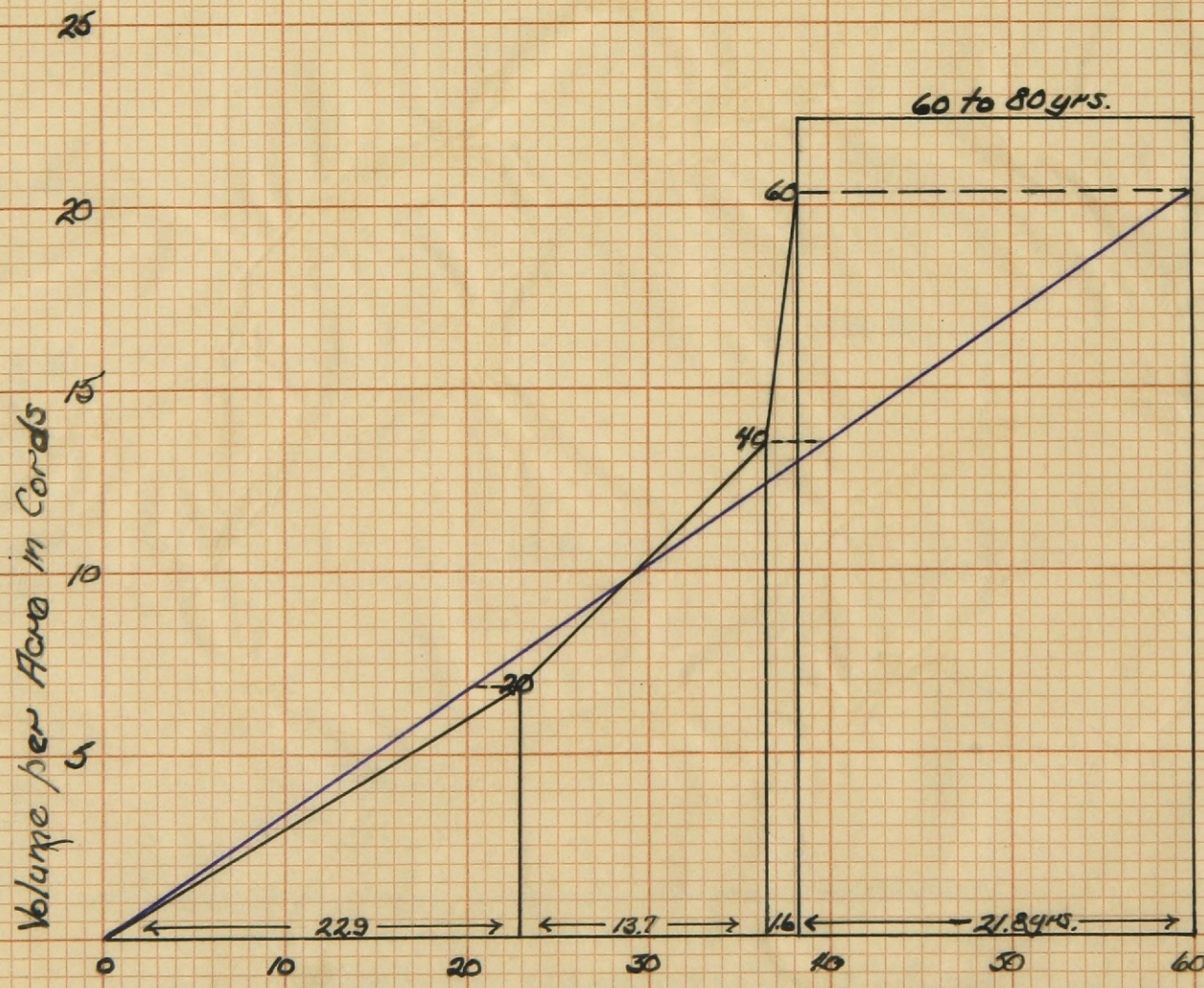
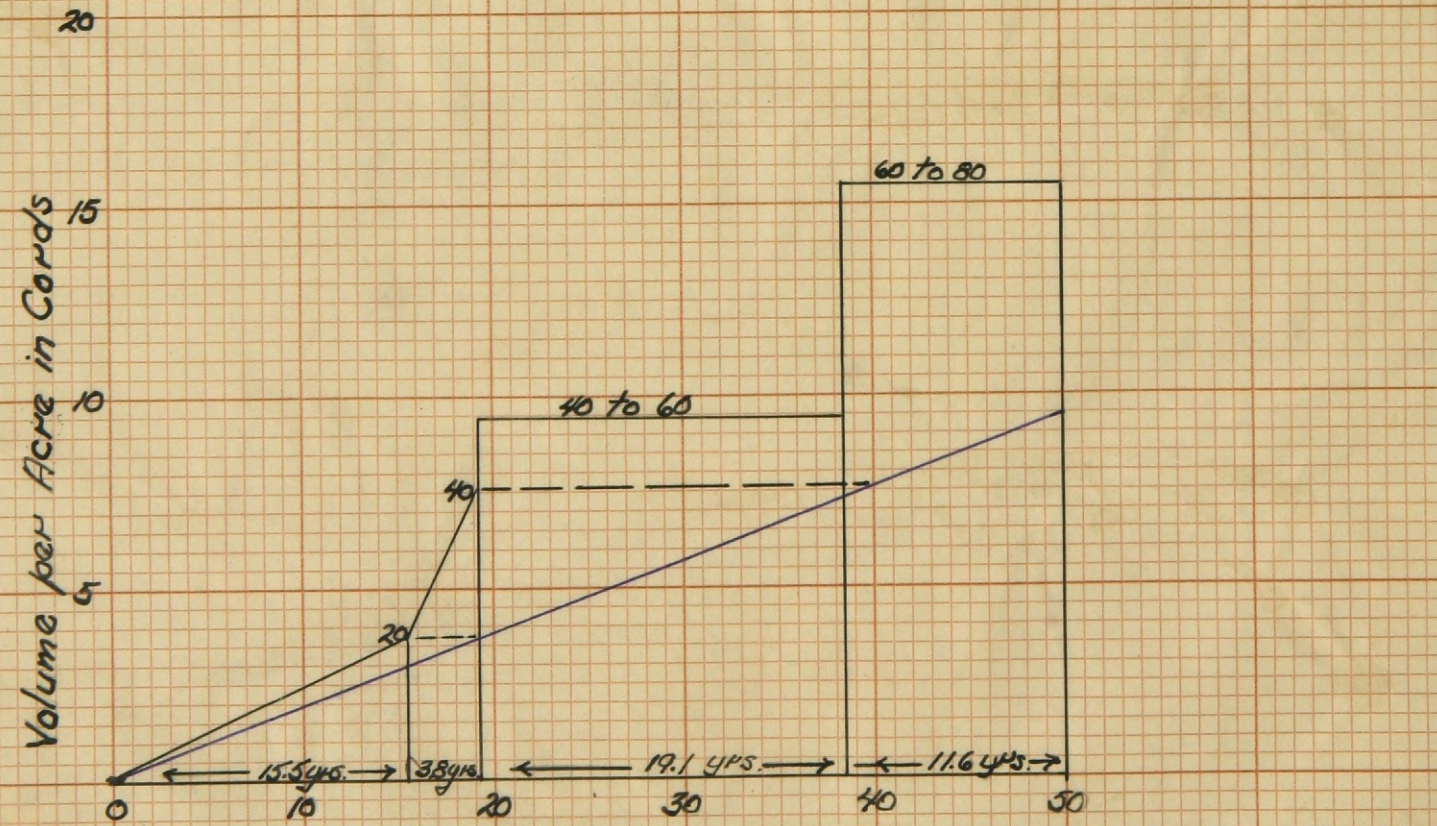
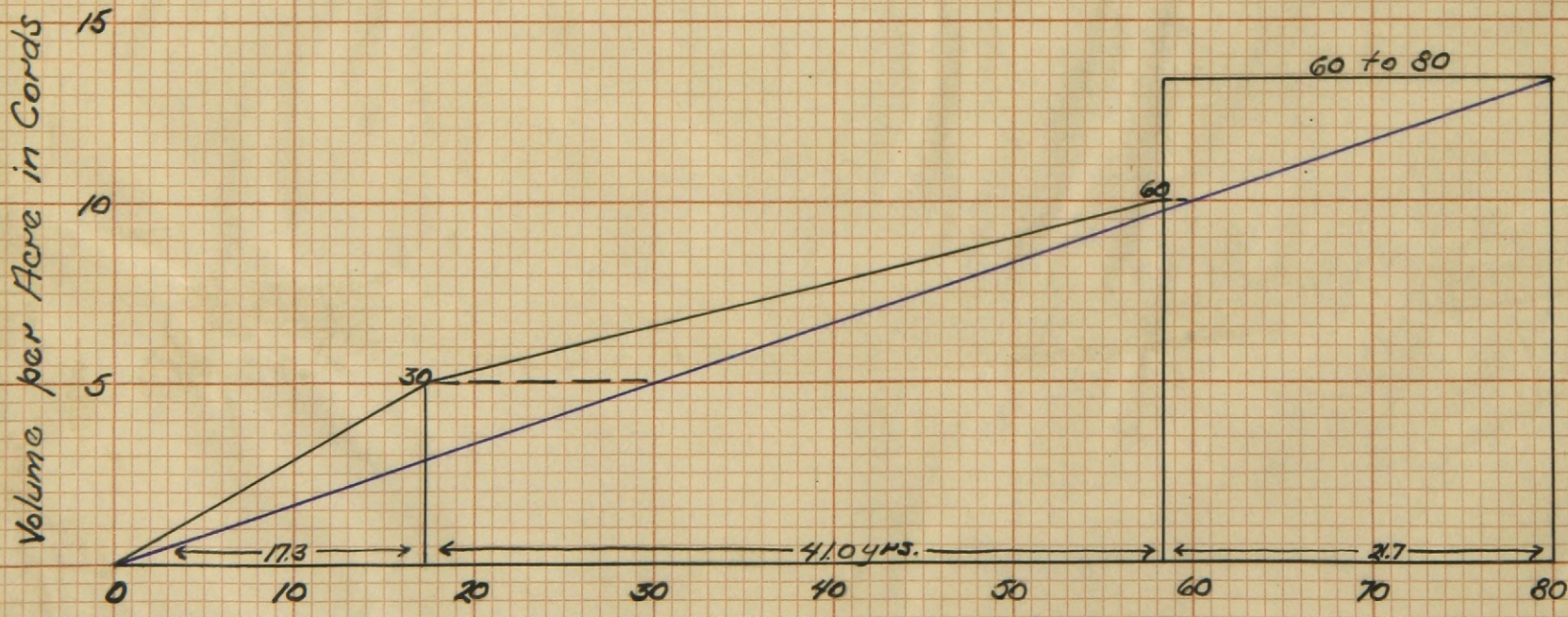


Fig. 3 Jack Pine Type



Age of Stands and Representative Rotational Area of 50 Acres

Fig. 4 Aspen Type



Age of Stands and Representative Rotational Area of 80 Acres

Fig. 5 Spruce Type

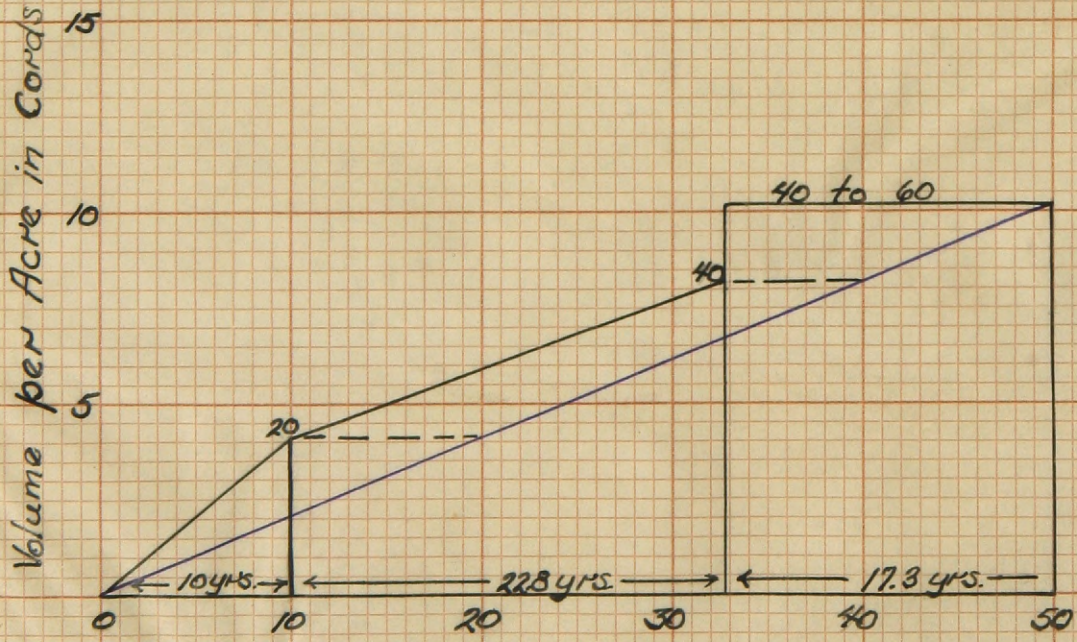


Fig. 6 Balsam Type

The annual cuts are calculated from each type individually:

Jack Pine Type:

The cut is to be maintained in timber at present older than 20 years for 40 years and the area occupied by that timber will be the basis of control and volume adjustments. This area is the total area of the 67,261 acres less the 25,659 acres occupied by the 0 to 20 age class, or 41,602 acres.

$$\text{Annual cutting area} = \frac{41,602}{40} = 1,040 \text{ acres}$$

First Period (61 to 80 age class) 24 years
60 to 80 age class-------24,526 acres
Cut will take in time $\frac{24,526}{1,040}$ or about 24 years.

There will be further growth, but there is no available data as to the amount and therefore present volume as per survey will be used as a conservative figure.

Annual cut should approximate------ $\frac{581,320 \text{ cords}}{24 \text{ years}}$ or 24,220 cords

Second Period (41 to 60 age class) 1 to 2 years.
41 to 60 age class------1,720 acres
Cut be taken in time $\frac{1,720 \text{ acres}}{1,040 \text{ acres}}$ or 1 to 2 years.

Mid-point will be reached in about 25 years. Average age when cut will be 75 years. Yield will be that of 61 to 80 class, or 22.41 cords per acre. Annual cut will approximate 1,040 acres x 22.41 cords or 23,320 cords.

Third Period (21-40 age class) 14 to 15 years.
21 to 40 age class-----15,356 acres
Cut will take in time $\frac{15,356 \text{ acres}}{1,040 \text{ acres}}$ or 14 to 15 years

Mid-point will be reached in about 33 years. Average age when cut will be 63 years. Yield will be that of 60 year old timber, or 20.33 cords per acre.

Annual cut will approximate 1,040 x 20.33 cords or 21,100 cords.

After the third period has elapsed, the condition of growing stock will approximate regularity. (Figure 7) Strict area regulation can be initiated at that time. The annual cutting area will be $\frac{67,261 \text{ acres}}{60 \text{ years}}$ or about 1,122 acres x 20.33 cords or about 22,500 cords.

Aspen Type

First Period-----12 years

Cut to come from the 61-80 year age class. There will be further growth but there is no available data as to the amount and therefore present volume as per survey will be used as a conservative estimate.

Annual cut should approximate $\frac{179,146 \text{ cords}}{12 \text{ years}}$ or 14,940 cords

Second Period-----19 years

Cut to come from the present 41-60 age class. Mid-point will be reached in 21 years. Average age when cut will be

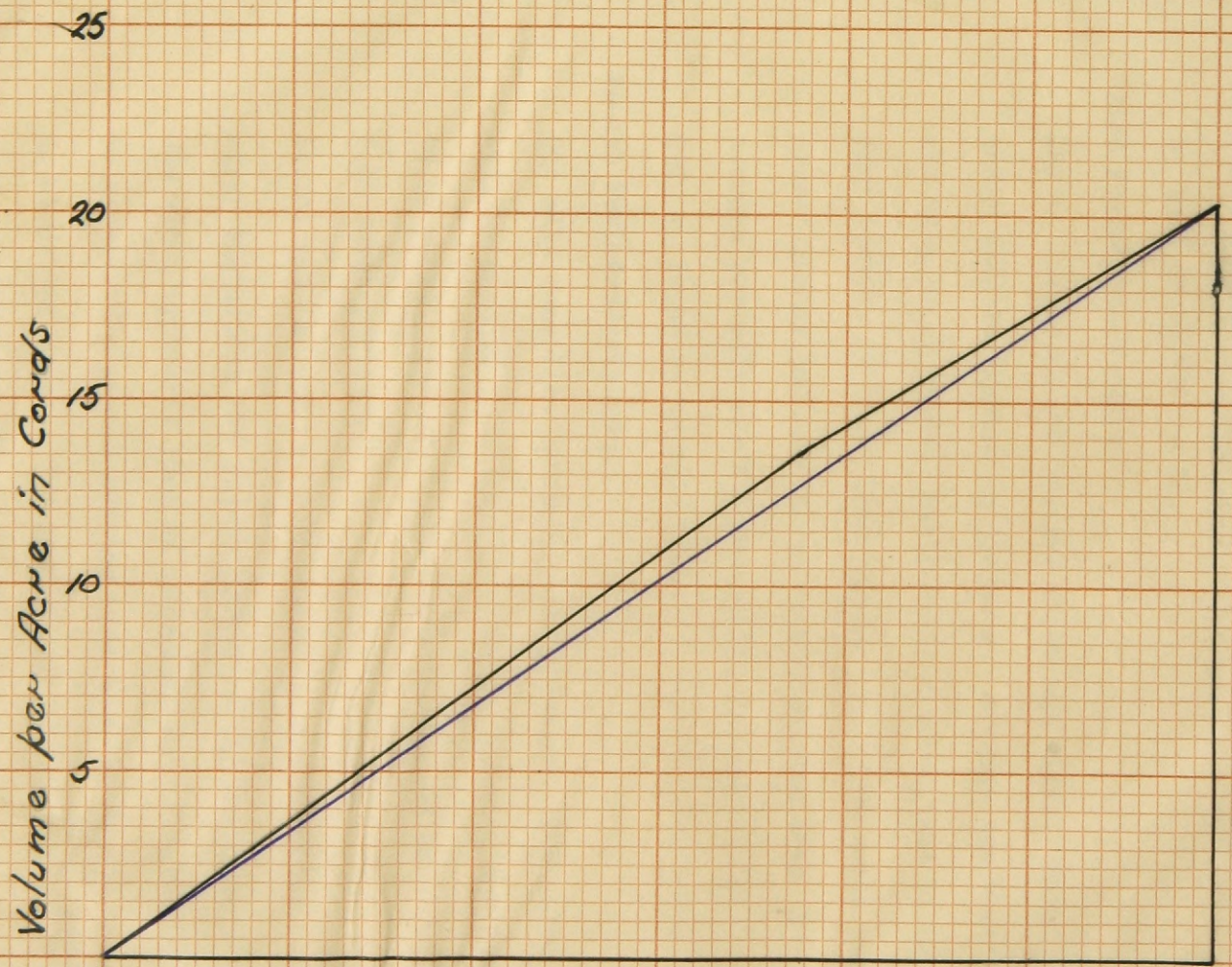


Fig. 7 Jack Pine Type After First Rotation

71 years. Yield will be about that of 70 year timber, or 15.5 cords per acre.

Annual cut will equal annual cutting area x average yield per acre. Annual cut for period = 998 acres x 15.5 or 15,470 cords.

Third Period-----4 years.

Cut to come from the present 21-40 age class. Mid-point will be reached in 33 years. Average age when cut will be 63 years. Yield will be about that of 60 year timber, or 15.5 plus $\frac{24.91}{2}$ or 12.45 cords per acre. Annual cut will equal annual cutting area x average per acre yield. Annual cut for period = 998 x 12.45 or 12,430 cords.

Fourth Period-----15 years

Cut will come from present 0-20 age class. Mid-point will be reached in 42 years. Average age when cut will be 52 years. Average yield will be that of 50 years or 9.41 cords per acre.

Annual cut = 998 x 9.41 cords = 9,390 cords.

After completing the fourth period of the regulatory cut the aspen type will then be regulated on a rotation of 50 years. The annual cutting area will be $\frac{49,879}{50}$ acres $\frac{}{\text{year}}$ or about 998 acres. The annual cut will be 998 x 9.41

cords or 9,390 cords.

Spruce Type

First Period-----22 years

Cut to come from the 61-90 age class. There will be further growth but there is no available data as to the amount of growth and therefore present volume as per survey will be used as a conservative estimate. Annual cut should approximate $\frac{179,397 \text{ cords}}{22 \text{ years}}$ or 8150 cords.

Second Period----41 years

Cut to come from the present 31-60 age class. Mid-point will be reached in 42 years. Average age when cut will be 87 years. Yield will be that of 80 years or 13.34 cords per acre. Annual cut will equal annual cutting area x average per acre yield. Annual cut for period = 617 x 13.34 or 8,230 cords.

Third Period-----17 years.

Cut to come from the present 0 - 30 age class. Mid-point will be reached in 71 years. Average age when cut will be 86 years or 13.34 cords per acre. Annual cut = 617 x 13.34 or 8,230 cords.

Completing the first rotation in the spruce type, regularity of the growing stock will be the effect. The annual cutting area will remain the same, $\frac{49,362 \text{ acres}}{80 \text{ years}}$ or about 617 acres. The annual cut will be 617 acres x 13.34 cords or about 8,230 cords.

Balsam Type

First Period---17 years

Cut to come from the 41-60 age class. There will be further growth but there is no available data as to the amount of growth and therefore present volume as per survey will be used as a conservative estimate.

Annual cut = $\frac{9,555 \text{ cords}}{17 \text{ years}}$ or 563 cords.

Second Period---23 years

Cut to come from the present 21-40 age class. Mid-point will be reached in 28 years. Average age when cut will be 58 years. Yield will be that of 50 years or 10.22 cords per acre. Annual cut will equal annual cutting area x average per acre yield. Annual cut fore period = 539 acres x 10.22 cords or 551 cords.

Third Period---10 years

Cut to come from present 0-20 age class. Mid-point will

be reached in 45 years. Average age when cut will be 55 years. Yield will be that of 50 years or 10.22 cords per acre. Annual cut = 539 acres x 10.22 cords or 551 cords.

When the first rotation in the balsam type has elapsed, regularity of the growing stock will be the effect. The annual cutting area is $\frac{2697 \text{ acres}}{50 \text{ years}}$ or about 539 acres. The annual cut will be 539 acres x 10.22 cords or about 551 cords.

The annual cuts of each type, after the first rotation, may be more than predicted if subsequent yield investigations show that the empirical data for yields at rotation age were too low.

THE CUTTING BUDGET---SUMMARY

Anmual Cut in Cords

Period	Jack Pine Type	Aspen Type	Spruce Type	Balsam Type	Total
1936-1948	24,220	14,950	8,150	563	47,883
1949-1953	24,220	15,470	8,150	563	48,403
1954-1958	24,220	15,470	8,150	551	48,403
1959-1960	24,220	15,470	8,230	551	48,471
1961-1962	23,320	15,470	8,230	551	47,571
1963-1967	21,100	15,470	8,230	551	45,351
1968-1971	21,100	12,430	8,230	551	42,311
1972-1976	21,100	9,390	8,230	551	39,271
1977-1986	21,100	9,390	8,230	551	39,271
1987-1996	21,100	9,390	8,230	551	39,271
1997-1999	22,500	9,390	8,230	551	40,671
2000-2016	22,500	9,390	8,230	551	40,671
2000-----	22,500	9,390	8,230	551	40,671

APPENDIX

GENERAL TYPE INFORMATION

Reproduction---An area supporting seedlings (trees up to 6' in height) averaging 200 or more per acre. A lower stocking than this is classed as a non-timber type.

Saplings---An area supporting saplings (trees between 6' high and less than 4.6" DBH)averaging 150 or more per acre or an average spacing of 17 x 17 feet. A lower stocking of saplings than this is classed as a reproduction or non-timber type.

Poles---An area supporting poles (trees between 4.6" and 9.5" DBH) averaging not less than 100 stems 6" to 9.6" (6" to 7.6" for jack pine,aspen) DBH per acre or ten poles per chain. The exceptions of this class are jack pine, spruce, and balsam types where a minimum of five cords per acre will be the criterion, if less than 100 trees will produce this volume. A lower stocking than this will be classed as saplings, reproduction or a non-timber type.

Saw logs---An area supporting trees over 9.5" DBH (7.5" DBH for jack pine and aspen) averaging not less than 3,000 feet BM per acre.

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
F.A. SILCOX FORESTER

SUPERIOR NATIONAL FOREST
MINNESOTA
4TH PRINCIPAL MERIDIAN
1934

Scale
Miles

LEGEND
Purchase Unit Boundary
National Forest Boundary
Good motor road
Poor motor road
Trail
Railroad in use Abandoned R.R.
Telephone line
Supervisor's headquarters
Ranger station
Lookout station
House, cabin, or other building

INDIAN RESERVATION 25D

Kawishiwi Working Circle

Figure 2

SUPERIOR NATIONAL FOREST BOUNDARY LINE

LAKE SUPERIOR

HUNTERS ISLAND

MESABA

PURCHASE

UNIT

Supervisor Headquarters at Duluth, Minn.

Compiled at District Office, Denver, 1929 from U.S.G.S. Survey, G.L.O., Forest Service, and other surveys by H.E.M. Connell and F.E. Washburn. Traced by P.F. Burris 1929. Corrected at Regional Office Milwaukee, Wis. July 1934 by R.A. Dinsel & C.H. Miller.